Design and Build a Children's Temperature Monitoring System Using the MLX90614 Temperature Sensor and NODEMCU ESP-12E Based on Android

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Abstract

The degree of children's health reflects the nation's health status, because children as the nation's next generation have abilities that can be developed in continuing the nation's development. The limited parental monitoring of children, so the authors make a child temperature monitoring device that can make it easier for parents to monitor their child's temperature in real time. This study uses a sensor temperature of the infrared MLX90614, NodeMCU ESP-12E as a controller programmed with the Arduino software idea later in the show via the LCD and the application blynk. This system was developed based on the needs of the children's monitoring system. The results of this research are that a child temperature monitoring system has been realized that can monitor the condition of a child's body in real time. Method used is to compare data between Thermometer Gun with sensor systems ML X90614, then obtained an average difference of 0.019^0C and an average error of 0.053%.

Keywords: *Infrared sensor, MLX90614, real time, monitoring.*

I. Introduction

THE technology development at this time is going very fast. One of the developments in internet technology at this time is the development of the Internet of Things. Things. IoT is a computing concept that describes a future where every physical object can be connected to the internet and can identify by itself between other devices [1].

One of the realizations of current technological developments is the development of technology in the field of monitoring children's temperature over a long distance in real time. This study aims to monitor an object located at a great distance with the help of an infrared temperature sensor that is emitted to the body. This study uses the NodeMCU ESP-12E module.

II. Materials and Methods

A. MLX90614 Infrared Temperature Sensor

The MLX90614 infrared sensor is a sensor that is used to measure temperature by utilizing infrared radiation. The MLX90614 sensor is specially designed to detect infrared radiation and automatically calibrates the infrared radiation energy into a temperature scale. With a fairly high level of accuracy, namely 0.02^0C and equipped with automatic calibration that has been programmed into the module, this child's temperature monitoring system uses the MLX90614 sensor.

The MLX90614 is an infrared thermometer for noncontact temperature measurement. Both the IR sensitive thermopile detector chip and ASIC signal conditioning integrated in the packing sensor TO-39 models are the same. The signal conditioner integrated into the MLX90614 is a low noise amplifier, 17-bit ADC and a powerful DSP unit that achieves the high accuracy and resolution of the thermometer. The MLX90614 sensor is a sensor that is used to measure temperature by utilizing infrared wave radiation. The MLX90614 sensor is specially designed to detect infrared radiation energy and has automatically been designed so that it can calibrate infrared radiation energy to a temperature scale [2].

Figure 1. Breakout board GY-906

On the Gy-906 Breakout Board, there is a pull up resistor in it as well as a voltage regulator. So it can be used with voltages from 3-5 volts. The Gy-906 Breakout Board has Vin, GND, SCL and SDA output pins. The Gy-906 Breakout Board has a 17-bit ADC, which means that it has an output of 17 bits of digital data and the accuracy of the conversion value ranges from 0 to 131,071. 131071 is obtained from (2n - 1) 217 = 131072, the greater the number of bits the higher the level of accuracy. ADC is usually labeled A0 to A5. On other boards, the pins marked A, the ADC are analog pins [3].

B. NodeMCU ESP-12E

NodeMCU ESP-12E is a microcontroller with a smaller board than other microcontrollers, has been integrated with a Wi-Fi module that makes it easy to create internet-based projects and includes the ESP8266 type, the type used is the eLua firmware based ESP-12E. The NodeMCU is also equipped with a reset button, flash, and has a 3.3V regulator IC of type AMS1117 so that it can work with an input voltage of more than 5V. NodeMCU.

Figure 2. Module NodeMCU ESP-12E

This microcontroller can be programmed via the Arduino IDE with the esp8266 library, so that it can be easily programmed with the Arduino programming language used for IoT projects that the ESP-12E has a 10-bit ADC with only 1 input, so a multiplexer is needed to read more than one analog input. The analog input on the ESP-12E has a maximum voltage of 5 Volts. Meanwhile, the converter from PC to ESP-12E uses IC CP2102 and the working voltage is 5 VDC [4].

C. BLYNK

Blynk is a server service used to support Internet of Things projects. This server service has a mobile user environment for both Android and iOS. The blynk application as an IoT supporter can be downloaded via Google play. Blynk supports a variety of hardware that can be used for Internet of Things projects. Blynk is a digital dashboard with a graphical interface facility in making the project. Adding components to Blynk Apps by means of Drag and Drop makes it easier to add input / output components without the need for Android or iOS programming skills [5] .

D. Tools and materials

The tools used in this research include:

1. NodeMCU ESP-12E
2. MLX90614 sensor
3. LCD Oled 0.91 display
4. Object (human)
5. Asus laptop
6. Arduino Programming Language
7. IDEA
8. Blynk Apps.

E. Block Diagram Design

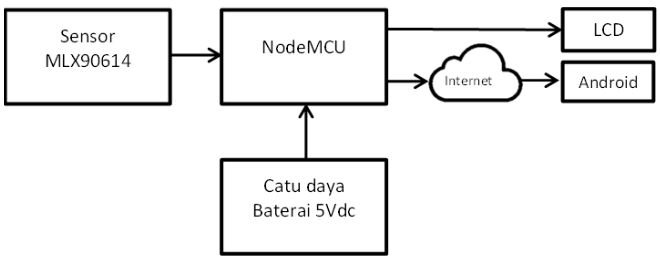

Figure 3. Block diagram design

The MLX90614 infrared sensor is an input that is used to read the child's body temperature. The MLX90614 infrared sensor works at a voltage of 3 Vdc to 5 Vdc. The process of the temperature measurement system uses the MLX90614 infrared sensor, by absorbing the infrared light emitted by an object. This temperature change will get an analog output voltage, then converted via the ADC into a voltage signal that is sent to the microcontroller, namely to NodeMCU ESP-12E as a microcontroller as well as a WiFi module. The data that has been received by NodeMCU ESP 8266 is then processed so that what was only a change in voltage becomes temperature using the Arduino Ide programming language. After the program is processed, the output will be displayed on the LCD in the form of temperature. The output is also sent to the blynk server using a WiFi module, then the data is downloaded using android via the application so that it can be displayed on android. DC voltage source as a voltage source to turn on the microcontroller and sensors.

III. Results and Discussions

A. Design Results

Figure 4. Physical forms of tools

The image above is the physical form of the external device in the form of a hexagon prism with a side length of 4 cm in which there is a microcontroller, MLX90614 sensor and an LCD which is connected to a single system which can be seen in the image below

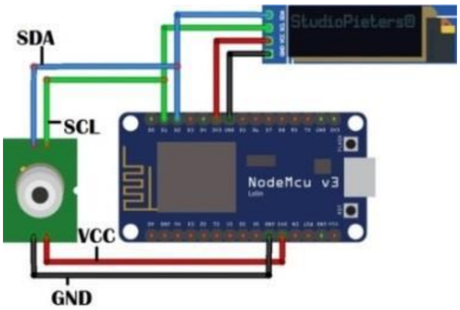

Figure 5. Wiring system diagram

The steps for designing the MLX90614 sensor system are by connecting the NodeMCU ESP-12E with the MLX90614 sensor which has 4 pins, namely Vin, GND, SCL, SDA. The Vin pin is connected to the 3.3V pin on the NodeMCU, the GND pin is connected to the GND on the NodeMCU, the SCL pin is connected to D1 on the NodeMCU, and the SDA pin is connected to the D2 pin of NodeMCU.

B. MLX90614 Sensor System Test Results

Testing of the MLX90614 sensor system was carried out with a sample of a 6 year old boy who was in good health. The results of temperature measurement using the MLX90614 sensor system with comparable parameters using a thermometer gun with the Non-Contact CP600 Infrared Thermometer type. This measurement is carried out for 10 seconds and the sensor is placed in the same place, namely the tip of the finger.

Table 1. Data measured under normal temperature

Testing	Thermometer Gun (^0C)	System of MLX900614 (^0C)	Deviation (^0C)	Error (%)
1	35.4	35.39	0.01	0.028
2	34.4	34.37	0.03	0.087
3	34.7	34.69	0.01	0.029
4	35.6	35.69	0.09	0.252
5	34.8	34.81	0.01	0.029
6	34.7	34.75	0.05	0.143
7	34	33.99	0.01	0.029
8	33.9	33.87	0.03	0.088
9	35.8	35.83	0.03	0.083
10	35.5	35.55	0.05	0.141
11	35.2	35.21	0.01	0.028
12	33.8	33.79	0.01	0.029
13	35.4	35.43	0.03	0.085
14	33.6	33.63	0.03	0.089
15	35.6	35.61	0.01	0.028
16	35.7	35.75	0.05	0.139
17	35.5	35.53	0.03	0.084
18	33.8	33.77	0.03	0.089
19	35.4	35.45	0.05	0.141
20	34.1	34.09	0.01	0.029
Avarage	34.84	34.86	0.015	0.042

Table 2. Data from normal temperature measurement

Testing	Thermometer Gun (^0C)	System of MLX900614 (^0C)	Deviation (^0C)	Error (%)
1	36.7	36.63	0.07	0.191
2	36.8	36.85	0.05	0.136
3	36.6	36.42	0.18	0.494
4	36.6	36.77	0.17	0.462
5	36.7	36.51	0.19	0.520
6	37.1	37.11	0.01	0.027
7	37	37.05	0.05	0.135
8	37	36.99	0.01	0.027
9	37.1	37.13	0.03	0.081
10	37	37.17	0.17	0.457
11	36.5	36.42	0.08	0.219
12	36.4	36.5	0.1	0.274
13	36	36.22	0.22	0.607
14	36.3	36.34	0.04	0.110
15	36.5	36.52	0.02	0.055
16	37.1	37.02	0.08	0.216
17	36.8	36.64	0.16	0.436
18	36.8	36.7	0.1	0.272
19	36.6	36.84	0.24	0.651
20	36.4	36.65	0.25	0.682
Avarage	36.7	36.72	0.024	0.065

Table 3. Measurement data above normal temperature

Testing	Thermometer Gun (^0C)	System of MLX900614 (^0C)	Deviation (^0C)	Error (%)
1	37.2	37.19	0.01	0.027
2	39.7	39.65	0.05	0.126
3	37.1	37.19	0.09	0.242
4	39.5	39.59	0.09	0.227
5	39.5	39.57	0.07	0.177
6	38.2	38.21	0.01	0.026
7	38.2	38.27	0.07	0.183
8	39.1	39.15	0.05	0.127
9	37.7	37.69	0.01	0.026
10	38.2	38.21	0.01	0.026
11	39	39.01	0.01	0.025
12	38.6	38.61	0.01	0.025
13	37.8	37.77	0.03	0.079
14	37.6	37.61	0.01	0.026
15	38.7	38.67	0.03	0.077
16	38.6	38.59	0.01	0.026
17	37.8	37.83	0.03	0.079
18	38.7	38.75	0.05	0.129
19	38.8	38.85	0.05	0.129
20	38.8	38.79	0.01	0.026
Avarage	38.44	38.46	0.02	0.052

Based on Table 1, Table 2 and Table 3, data on the results of system testing that have been carried out. The average difference value is 0.015^{0}C with a percentage error of 0.042% in temperature measurements below normal temperatures, the average difference is 0.024^{0}C with an error percentage of 0.065% in normal temperature measurements and the average difference is obtained. 0.02^{0}C with a percentage error of 0.052% in temperature measurements above normal temperatures. So, from the three tests, it is obtained an average difference value of 0.019^{0}C and an error of 0.053%, the difference or error value is smaller than the accuracy level value of the MLX90614 sensor, which is 0.02^{0}C. This shows that this sensor is able to run perfectly. So that it can replace conventional temperature measuring instruments because this sensor has a good level of accuracy.

C. Blynk Application Testing

Blynk application testing is done by way of equalizing the temperature value displayed on the LCD and blynk. As in Figure. 6.

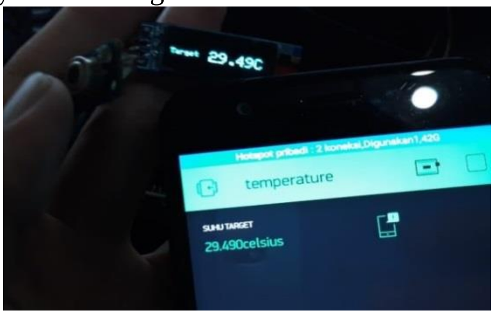

Figure 6. Blynk data transfer testing

After testing the transmission of data, then testing the sending of temperature data is carried out 20 times in order to find out the error rate in sending data.

Table 4. Blynk test data

Testing	Temperature on LCD (^{0}C)	Temperature on Blynk Application (^{0}C)	Deviation (^{0}C)	Error (%)
1	36.40	36.40	0	0
2	36.20	36.20	0	0
3	36.42	36.42	0	0
4	36.29	36.29	0	0
5	35.8	35.8	0	0
6	36.26	36.26	0	0
7	36.10	36.10	0	0
8	36.64	36.64	0	0
9	36.21	36.21	0	0
10	36.68	36.68	0	0
11	36.45	36.45	0	0
12	36.19	36.19	0	0
13	36.22	36.22	0	0
14	36.34	36.34	0	0
15	36.31	36.31	0	0
16	36.15	36.15	0	0
17	36.26	36.26	0	0
18	36.23	36.23	0	0
19	36.22	36.22	0	0
20	36.12	36.12	0	0
Avarage	36.27	36.27	0	0

In the data table above, it can be seen that the average difference is 0 and error is 0% from the 20 tables above. The data sent to the blynk application is the same as the temperature displayed on the LCD. This shows the measurement data that you want to display via an Android smartphone wirelessly works well and is suitable for use. The notification when the temperature is above 37^{0}C can be seen in Figure 7.

Figure 7. Blynk notification testing

A notification will appear and sound when the temperature is above 37^{0}C. In this test, it goes according to what has been programmed on the Arduino Ide.

IV. CONCLUSIONS

A system for monitoring body temperature in children using a NodeMCU ESP-12E microcontroller and an MLX90614 sensor has been realized which can be monitored using the Blynk application in real time. A body temperature monitoring system has been realized with the conditions of the three measurement data, so the average difference is 0.019^{0}C and an average error of 0.052% with the comparison of the thermometer gun. Based on the results of testing the Blynk application that has been carried out, that sending data on the MLX90614 sensor system to the Blynk application has a 0% error percentage and there is a warning system in the form of a notification on the Blynk application when the temperature is above 37^{0}C.

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